AD WEATHER CAN ruin your day, but extreme weather can be downright dangerous. A thunderstorm, for example, can postpone a baseball game, but a hurricane packing heavy rain and 120-mile-per-hour winds can flood towns and rip roofs off buildings. While hurricanes and other violent weather occur frequently on our planet, thankfully, we don’t encounter them every day. Our solar-system neighbors, however, are not so lucky. Imagine waking up every day to hurricane-force winds of 200 miles per hour sweeping across the planet, or harmful sulfuric acid rain falling on a scorching hot planet! These kinds of wild weather are routine occurrences on some of our solar-system planets and moons.

Coupled with the nasty weather on these nearby worlds is the unfriendly terrain. Earth has several

Continued, page 2…
active volcanoes, giant mountain ranges, and vast, deep canyons. But it also has lots of liquid water in the form of oceans, lakes, and rivers. Our solar-system neighbors have ice mountains, frigid, liquid methane lakes, volcanoes that spew poisonous sulfur dioxide, and a colossal canyon as long as the continental U.S.

This Star Witness news story offers a brief overview of the extreme weather and geography on Earth and on some of the planets and moons in our solar system. It is the first in a series of Star Witness news stories that will compare Earth with our solar-system neighbors.

Which solar-system object has the most active volcanoes? How do Earth’s storms compare with those on other planets in our solar system? Read on to find out.

**WEATHER IN THE EXTREME**

**• Going from cold to hot**

Put on your long johns, wool socks, parka, and gloves if you travel to Antarctica, the coldest spot on Earth. Temperatures there can drop to minus 120 degrees Fahrenheit. But trade in your parka for a wide-brimmed hat and lots of sunscreen and bottles of water to visit the hottest place on our planet, Death Valley, Calif. The highest temperature recorded in that hot spot is a sizzling 134 degrees Fahrenheit.

Those extreme temperatures, however, are mild compared with the temperatures on Venus and Pluto. Venus’s average surface temperature is a scorching 860 degrees Fahrenheit, which is hot enough to melt lead. At the other extreme is Pluto, where temperatures reach minus 360 degrees Fahrenheit, cold enough to keep its giant mountain ranges covered in ice.

Mars seems a little more Earth-like. Daytime summer temperatures can reach 80 degrees Fahrenheit. At night, however, temperatures can dip to a frigid minus 110 degrees Fahrenheit.

**• When it rains, it pours**

We have all been caught outside in a rainstorm. Rain waters our plants and keeps our grass green. Some parts of the world, such as the Sahara Desert in Africa, receive very little rain. Others, such as India during the late summer monsoon season, can be subject to widespread flooding.

Some of our solar-system neighbors have rain, too, but it is not made up of water, as it is on Earth. Venus has continuous showers of sulfuric acid rain. However, the acid rain evaporates before it reaches Venus’s surface because of the planet’s super-hot temperatures. Titan, Saturn’s largest moon, has rain that is made up of frigid liquid methane, hitting a bitterly cold surface, where the temperature is minus 290 degrees Fahrenheit. Although scientists have never detected the

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**Titan’s methane lake**

*NASA’s Cassini spacecraft* revealed a giant methane lake in the north polar region of Titan, Saturn’s largest moon. The lake is the same size as Lake Superior, the largest of the Great Lakes, shown to its right. This close-up view offers strong evidence for seas on Titan. Scientists theorize that the methane lake was created by liquid methane rain.

**Titan’s clouds**

*The Cassini spacecraft* took this image (at right) of a vast cloud system covering Titan’s north pole. This system may be the source of the liquid methane that fills Titan’s many lakes.

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*Continued from page 1…*

*Continued, page 3…*
Wind patterns on Earth
Prevailing directions of Earth’s winds between the Arctic and Antarctic Circles

**Westerlies**

**Northeast trades**

**Southeast trades**

**Westerlies**

*Image: NASA Visible Earth (base map) and STScI Graphics*

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**Continued from page 2…**

methane rain, they have images of vast methane lakes that are the same size as the Great Lakes in the U.S.

**Blowing in the wind**

Powerful winds on Earth can uproot trees, toss over cars, and destroy houses. The fastest winds were clocked at roughly 250 miles an hour, but this happens only about once a decade. Every single day, 200-mile-per-hour winds whip around Jupiter. Storms on Jupiter have been clocked at over 400 miles per hour. The winds on Saturn are

*Continued, page 4…*

**Jupiter’s wind-whipped clouds**

This NASA Hubble Space Telescope image reveals Jupiter’s trademark bands of turbulent clouds, which whip around the planet at hundreds of miles an hour. The giant oval-shaped feature at lower right is Jupiter’s famous Great Red Spot, a storm that has been raging for hundreds of years.

*Image: NASA/R. Beebe and A. Simon (New Mexico State University)*
Dust storms on Earth

At right: A dust storm sweeps across the Sahara Desert and moves out over the Atlantic Ocean in this image, taken by the Sea-Viewing Wide Field-of-View Sensor (SeaWiFS) instrument aboard the OrbView-2 satellite.

Below: A wall of dust sweeps towards a military camp in Iraq in 2005. Dust storms arise when strong winds kick up sand in dry, desert regions on Earth and Mars.

Clouds on Saturn can even faster. Clouds on Saturn can reach speeds of 1,100 miles an hour.

Strong winds can also kick up dust storms in dry regions on Earth, such as the Sahara Desert, and elsewhere in our solar system. Large dust storms, for example, have swept through the Sahara Desert in North Africa, turning day into night and making it hard to breathe and see. Dust storms on the dry surface of Mars, however, are fiercer. Hubble spotted one such storm in 2001 that grew to cover the entire planet within two weeks. Dust shrouded Mars for three months before fading away.

Ground view

Satellite view

IMAGE at top:
NASA/GSFC/SeaWiFS

IMAGE at right:
United States Marine Corps/
Cpl. Alicia M. Garcia

Continued from page 3...

Continued, page 5...
Global dust storm on Mars

These Hubble Space Telescope images reveal how global dust storms in the atmosphere of Mars can hide features on the planet’s surface. The image at left shows the planet months before the storm engulfed it. More than two months later, the storm has covered the entire planet. Seasonal global dust storms on Mars have been observed from telescopes for over a century, but this is the biggest storm seen in the past several decades.

Continued from page 4…

• Stormy weather

In 2005, a massive 400-mile-wide hurricane named Katrina struck New Orleans, La., and neighboring states. The storm packed winds of 100 to 140 miles per hour, toppling homes and causing widespread flooding. This hurricane, however, cannot compare to a colossal hurricane on Saturn. The eye of the Saturn hurricane is more than 1,000 miles across — 20 times larger than the average hurricane eye on Earth. This celestial tempest may have been raging for many years, though it is well beneath the force of the solar system’s mightiest storm: Jupiter’s Great Red Spot. The Great Red Spot is a storm larger than Earth that has been raging for hundreds of years.

Continued, page 6…
**UNFRIENDLY TERRAIN**

- **High on a mountain top**

Earth has plenty of mountain ranges. The Rocky Mountains and the Appalachian Mountains in the U.S. are just two of them. The highest mountain in the world is Mt. Everest in Nepal, rising more than 29,000 feet into the sky.

Earth’s moon has mountains, too. The Moon’s Mons Hadley Delta is 15,000 feet tall, and makes up part of the rim of a deep crater from an asteroid impact billions of years ago. The volcanic mountains on Mars are even taller, rising up to five times higher than Mt. Everest. Pluto, located on the outskirts of our solar system, has a different kind of mountain range, made up of ice. The ice mountains are about 11,000 feet tall. The New Horizons spacecraft spotted them for the first time when it flew by the dwarf planet in July 2015. The newly discovered mountains show that scientists are still making new discoveries in our solar system.

- **Spectacular natural wonders**

The Grand Canyon, located in the northwest corner of Arizona, was carved out millions of years ago by water. The canyon is one mile deep and about 100 miles long. The deepest canyon in the world is the Tsangpo Canyon, along the Yarlung Tsangpo River in Tibet. The canyon is almost 3.5 miles deep and is slightly longer than the Grand Canyon.

The Valles Marineris canyon on Mars is even deeper and much longer than Tsangpo Canyon, measuring 10 miles deep and stretching about 3,000 miles across, which is about the width of the continental U.S.

**Mt. Everest**

![Mt. Everest](image1.jpg)

Shown here is the north face of Mt. Everest, the highest mountain on Earth. Mt. Everest is part of the Himalayan mountain range in Asia.

**Mountain Mons Hadley Delta on the Moon**

Apollo 15 astronaut Jim Irwin stands next to an American flag on the Moon, with the 15,000-foot-tall Mons Hadley Delta mountain looming in the background. The Apollo lander and rover are nearby.

**The Grand Canyon**

![The Grand Canyon](image2.jpg)

The Grand Canyon in Arizona is one of Earth’s most spectacular canyons. Water carved out the canyon millions of years ago.

**Canyon Valles Marineris on Mars**

This image of Mars, taken by the Viking Orbiter 1 spacecraft, reveals the huge canyon Valles Marineris. The canyon stretches 3,000 miles across, which is as wide as the continental U.S.

**Outline of the U.S., to scale**

IMAGE: NASA/JPL-Caltech (Mars); STScI Graphics (overlay)
Volcano Olympus Mons on Mars

The inactive volcano Olympus Mons on Mars is as large as Arizona. It is almost three times taller than Mt. Everest, Earth’s highest mountain.

Stream channels on Earth

Taken from a NASA space shuttle, this image shows stream channels in the Republic of South Yemen, at the edge of a vast desert. The channels were carved long ago by water, when the region received lots of rain. But no water flows today. In this way, Yemen is a bit like solar-system neighbors such as Mars, consisting of empty channels where water once flowed.

Dry river beds on Mars

NASA’s Viking Orbiter took this image of networks of interconnecting dry river beds on Mars. These dry beds are similar to water-carved channels on Earth. The image suggests that Mars was once a warmer and wetter place with sufficient atmospheric pressure to retain liquid water on the surface.

• Mountains of fire

History has recorded many violent volcanic eruptions on Earth. In 1991, Mt. Pinatubo’s volcanic outburst in the Philippines produced the second largest eruption of the 20th century. Ash from the blast was ejected as high as 21 miles above Earth. Particles from the eruption created a layer of sulfuric acid haze in Earth’s atmosphere, dropping global temperatures by nearly 1 degree Fahrenheit between 1991 and 1993.

Yet, solar system volcanoes are much larger and much more active than those on Earth. Olympus Mons, an inactive volcano on Mars, spreads over an area as large as the state of Arizona. Jupiter’s moon, Io, has more than 400 active volcanoes, making it the most geologically active object in the solar system. Several volcanoes on Io produce plumes of sulfur and sulfur dioxide that rise as high as 300 miles above its surface.

• Down in the valley

Rivers are plentiful on Earth, and each river has a connection of streams that all flow into it. Some of Earth’s solar-system neighbors show evidence that they once had similar river systems. Observations of Mars, Venus, and Titan reveal a series of thin channels that lead to larger channels. Although now dry, these channels could have once been river systems.

• Icy caps

Like Earth, Mars has both northern and southern polar ice caps. Earth’s polar ice caps consist of water ice. Mars’s polar caps, however, are a combination of water ice and...
Continued from page 7…

carbon-dioxide ice. The Martian polar caps thaw in summer and freeze in winter, showing that our solar system’s planets are dynamic and changing.

Some of the moons in the outer solar system are completely covered in ice. They don’t have just polar caps. They have ice shells. And, in a few cases, scientists think there is water beneath the icy crust, perhaps in the form of subsurface oceans.

• Water, water everywhere

The signature of our planet is its oceans. Earth’s surface is covered mostly by water. Some of our solar-system neighbors may have oceans, too, but they are hidden from view under layers of ice. Beneath the icy crust of Europa, one of Jupiter’s moons, lies a liquid ocean that may have more water than Earth contains. Images of Europa’s surface show ice that has broken up into ice flows, suggesting that water beneath the surface is moving and cracking the ice. The ice on Europa is generally hundreds of miles thick.

NO PLACE LIKE HOME

If you really want a place that harbors life, then Earth is it. Our planet is neither too hot nor too cold. It has fierce storms and winds, but not at the extremes seen elsewhere in the solar system. The most awesome occurrences on Earth are moderate by cosmic standards. There is no place like home.

Earth is also our template for understanding the weather and geography on solar-system planets and moons. As scientists learn about our neighboring worlds, they realize how forbidding these places can be. They also document how wonderful our Earth is and how accommodating it is for life. Earth is our oasis in space. ★

SEE MORE Hubble images and read more Star Witness news stories at Amazing Space, NASA’s award-winning educational website for K–12 students and teachers.

http://amazingspace.org/news

Earth, our oasis in space

IMAGE: NASA/GSFC

Earth is the only world in our solar system that is known to harbor life. Our planet is neither too hot nor too cold. It has fierce storms and winds, but not at the extremes seen elsewhere in the solar system. There is no place like home.